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ABSTRACT

Designed for Ohio educators responsible for planning programs to prepare high school students for careers in the manufacturing industry, this document presents an overview of Ohio's Integrated Technical and Academic Competencies (ITAC) system of career-focused education and specific information about the manufacturing subcluster of the industrial and engineering systems ITAC career cluster. The first half of the document, which introduces the ITAC system's underlying principles and elements, contains the following items: (1) descriptions of the three types of integrated competencies (core, career cluster, and specialization) forming the ITAC model; (2) guidelines for using ITAC; (3) an explanation of the components of the 51 core ITAC; and (4) a table detailing the academic connections in the core ITAC. The second half of the document, which focuses on the manufacturing subcluster ITAC, is divided into six sections that each focus on one of the following strands deemed essential for all careers: solving problems and thinking skillfully; communicating effectively; applying technology; working responsibly; planning and managing a career; and managing resources. Each section contains the following items: expectation; competencies; sample scenario; sample guiding questions; connections to core

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ITAC competencies; connections to academic models; and connections to Ohio's proficiency tests and ACT Work Keys. (MN)

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Industrial & Engineering Systems Career Cluster

ITAC

for Career-Focused Education

Manufacturing Sub-Cluster

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ITAC
Integrated Technical & Academic Competencies

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Industrial & Engineering Systems Career Cluster ITAC

Manufacturing Sub-Cluster

The Industrial & Engineering Systems Career Cluster includes the entry-level, technical and professional career options within industrial- and engineering-related fields. This career cluster is divided into three sub-clusters: manufacturing, construction, and transportation. Each of these industries offer many career options depending upon the level of education and training one desires. The *manufacturing sub-cluster* includes all aspects of the manufacturing industry, from product design to production and delivery. Career opportunities in this industry may be obtained through a variety of educational pathways such as career-technical education, apprenticeships, on-the-job training, community colleges, or universities.

Sample career options within the manufacturing sub-cluster include—

- tool and die maker
- production specialist
- machinist
- welder
- product designer
- engineer
- CAM programmer
- engineering technician
- production manager
- purchasing agent

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The Arts

Math

Social Studies

Language Arts

Foreign Language

Science

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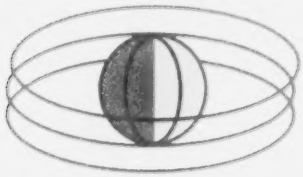
Career-Focused Education

Career-Focused Education combines high-level academics and technical skills with a real-life context for learning that maximizes students' present and future academic and career success. Career-focused education strengthens—

- proficiency test success
- integrated instruction
- partnerships between education and business & industry
- aquisition of transferable career skills



ITAC

Integrated Technical & Academic Competencies for Career-Focused Education

Ohio Department of Education
Division of Career-Technical and Adult Education

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Components of the ITAC System

Integrated Technical and Academic Competencies (ITAC) documents consist of competencies that integrate academic, technical, and employability knowledge, skills, and attitudes. ITACs are presented in resource documents that include the expectations, competencies, scenarios, and academic connections. ITACs are developed through—

- review and synthesis of national academic, employability, and occupational standards;
- review by teachers—both vocational and academic;
- validation by business and industry representatives; and
- direct links to Ohio's competency-based education (CBE) models, proficiency test learning outcomes, and ACT Work Keys® System.

ITAC Model

Three types of ITACs form this model:

Core ITAC – Consists of 51 competencies organized into six strands essential for all careers and sample work-related scenarios. Core ITAC represents what individuals need to know and be able to do to be successful in further education, in a career, and in life.

Career Cluster ITAC – Consists of the foundational competencies common to related occupations or industries and sample work-related scenarios. The six Career Cluster ITACs provide a broad foundation for entry-level, technical, and professional careers.

Specialization ITAC – Consists of competencies and sample scenarios critical to success in a specific industry or occupation within a career cluster. Currently, 55 Occupational Competency Analysis Profiles (OCAPs) represent the Specialization Competencies. As OCAPs are revised, they will become Specialization ITACs.

The ITAC system builds on and expands the Occupational Competency Analysis Profile (OCAP) system, which was designed primarily for occupation-specific vocational programs. The ITAC system provides a broader range of competencies, integrates academic knowledge and skills with technical content, and provides sample scenarios to illustrate work-related context. This system is a resource for ***both*** academic and technical teachers as they plan programs and instruction.

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How to Use ITACs

Integrated Technical and Academic Competencies (ITAC) documents are resources for planning programs. The competencies of the ITAC system integrate technical and academic content and are organized into three types, moving from broad to specific—core, career cluster, and specialization. The types are interrelated building blocks for program design. *Core* provides the broad competencies. *Career Cluster* incorporates use of *Core* competencies. *Specialization* incorporates application of both the related *Career Cluster* and *Core* competencies. These ITAC types can be integrated into the overall educational system as follows:

- The Core ITAC could be used to design learning experiences for all students.
- The Career Cluster ITACs—in combination with Core ITAC—could be used to guide courses or experiences in which students explore and develop essential competencies within one of the following career clusters:

  ✔ **Arts & Communication**

  ✔ **Business & Management**

  ✔ **Environmental & Agricultural Systems**

  ✔ **Health Services**

  ✔ **Human Resources/Services**

  ✔ **Industrial & Engineering Systems**

- Specialization ITACs—in combination with Core ITAC and Cluster ITACs—could be used for those programs, courses, and experiences with specific technical skill development.

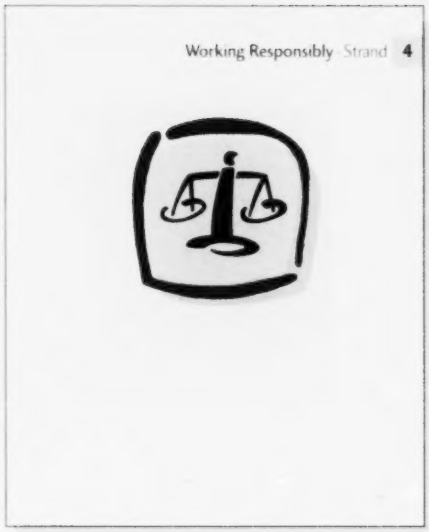
As a curricular and instructional planning tool, ITACs identify the knowledge, skills, and attitudes needed to help students prepare for academic and career success. ITAC documents foster the development of interdisciplinary projects and learning experiences by illustrating the relationships between broad-based career skills and academic content. Educators can use the components of the ITACs in a number of ways for classroom instruction:

- Competencies can be reviewed and relevant competencies selected for instruction.
- Connections that need to be made between competencies and academic skills can be identified.
- Scenarios can be used as a basis for learning experiences.

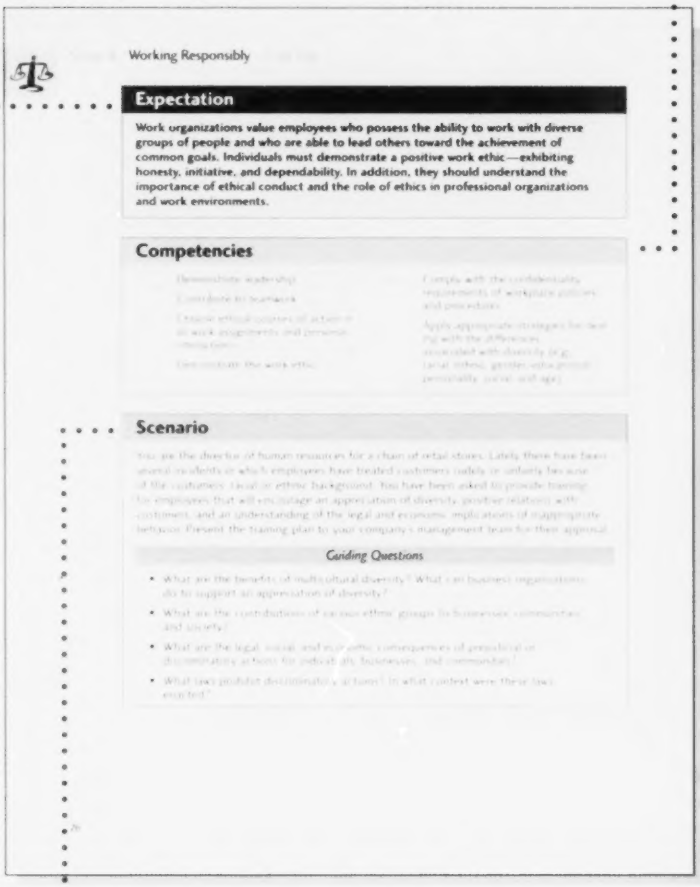
Components of Core ITAC

Expectation – a statement of desired workplace behaviors and their importance in the world of work.

Competencies – observable and measurable knowledge, skills, and attitudes essential to achievement of the expectation.



Each strand in Core ITAC has an introduction page which identifies the strand (in words and by icon).


Working Responsibly
Expectation
Work organizations value employees who possess the ability to work with diverse groups of people and who are able to lead others toward the achievement of common goals. Individuals must demonstrate a positive work ethic—exhibiting honesty, initiative, and dependability. In addition, they should understand the importance of ethical conduct and the role of ethics in professional organizations and work environments.
Competencies
Scenario
Guiding Questions

Sample Scenario – a real-life workplace situation requiring learners to apply the knowledge and skills reflected in the strand competencies.

Sample Guiding Questions – targeted questions to use in focusing learners' attention on knowledge and skills covered in the scenario.

Solving Problems and Thinking Skillfully

Communicating Effectively

Applying Technology

Working Responsibly

Planning and Managing a Career

Managing Resources

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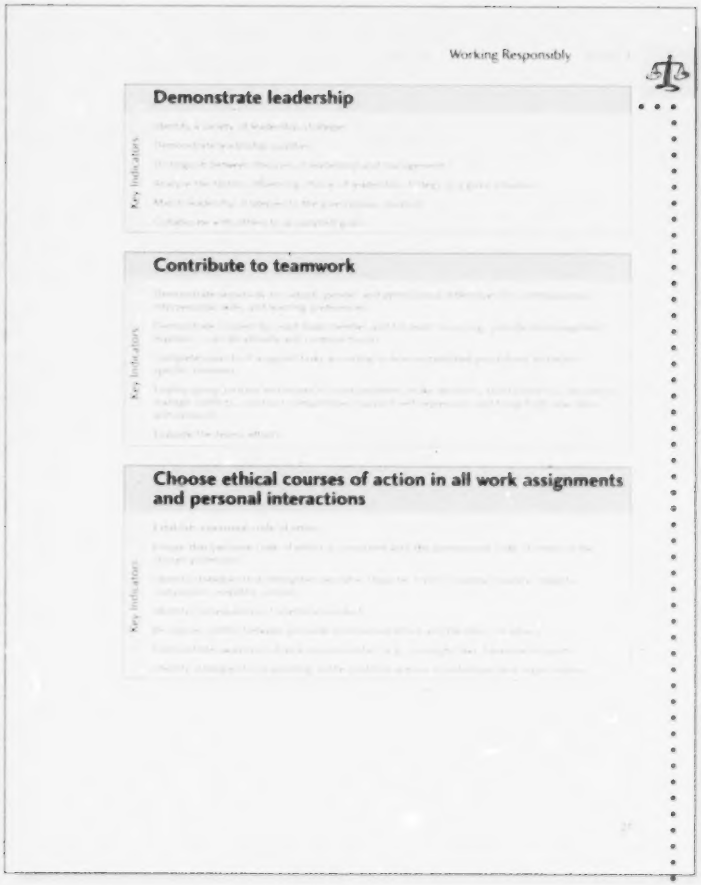
Connections to Academic Models – the percentage of objectives from Ohio's Competency-Based Education Models, grades PreK – 12, that relate to and/or reinforce the competencies in the given strand. Each academic area is represented by an icon.



Pages following the overview list each competency with its key indicators. Key indicators describe significant elements of competency performance.

The Arts

Mathematics

Social Studies

Language Arts

Foreign Language

Science

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Solving Problems and Thinking Skillfully - Strand 1

Core ITAC

Expectation

All individuals, regardless of career choice, must be able to think for themselves; initiate action on their own; and direct, modify, and assess their own work. Employers seek lifelong learners who can locate and use information. The following competencies specify the knowledge, skills, and attitudes needed to develop the capacity to assess problems and situations, anticipate what might happen next, and continuously search for creative solutions.

Competencies

Solve problems and make decisions in work-related situations

Read for information and understanding

Use observation skills to analyze work-related situations

Apply mathematical processes

Apply measurement and spatial skills

Apply statistical analysis skills

Analyze critical data to guide work activities

Utilize scheduling techniques to ensure that jobs are completed by the stated due date

Demonstrate knowledge of the economy and how it functions as a whole

Demonstrate knowledge of the economy as a framework within which decisions are made by individuals and groups

Scenario

You are among a team of architects hired to plan the revitalization of a deteriorating historic area in your community. In spite of a rich ethnic history and residents who are committed to seeing the area thrive, the neighborhood is plagued by inadequate housing, abandoned buildings, lack of transportation, crime, and declining businesses. The City Planning Commission is prepared to provide resources to encourage economic development, recreation areas, and better housing. Create a design for the neighborhood and present your plans to the commission for their approval.

Guiding Questions

- What alternative uses should be considered for the land to best meet the needs of the community and its citizens?
- What historic and current economic, social, and environmental factors should be considered in the creation of the plan?
- What data regarding the needs and concerns of citizens and businesses in the community would inform the design of the neighborhood? How should this data be collected, analyzed, and presented?

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Solve problems and make decisions in work-related situations

Key Indicators:

- Identify factors that influence problem solving and decision making
- Analyze the source of the problem or the situation requiring a decision
- Generate possible alternatives
- Analyze possible alternatives
- Match problem-solving and decision-making processes to the situation
- Use creative thinking processes to support solving problems and making decisions
- Justify solution or decision with evidence to support or refute alternatives
- Formulate action plans
- Implement action plans
- Evaluate action taken
- Monitor action plans
- Adjust action plans as needed

Read for information and understanding

Key Indicators:

- Locate needed information in written materials using formatting cues, skimming, and scanning
- Interpret written information, including manuals, graphs, and schedules
- Unlock the meaning of unknown or technical vocabulary using standard strategies (e.g., context clues, prefixes, suffixes)
- Locate key points, main ideas, relevant details, facts, and specifications in written materials
- Judge the accuracy, appropriateness, style, and plausibility of information, proposals, or theories in materials read

Use observation skills to analyze work-related situations

Key Indicators:

- Collect data through sensory perceptions—seeing, hearing, tasting, touching, and smelling
- Identify predictable patterns and relationships in given situations
- Monitor situations for deviations
- Identify patterns and relationships that create doubt, uncertainty, difficulty, or disappointment
- Devise appropriate responses to given situations
- Apply past observations to present work-related situations

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Apply mathematical processes

Key Indicators:

- Solve mathematical problems involving whole numbers and integers
- Solve mathematical problems involving fractions, mixed numbers, decimals, percentages, ratios, and proportions
- Apply systematic counting techniques and algorithmic thinking to represent, analyze, and solve problems
- Use estimates to determine reasonableness of proposed problem solutions
- Use appropriate technology in the solution of math-related problems
- Describe problem situations using numerical, symbolic, and graphical representations
- Apply combinations of algebraic techniques
- Represent problem situations with geometric models (including applying the properties of figures)
- Express mathematical ideas orally and in writing

Apply measurement and spatial skills

Key Indicators:

- Demonstrate knowledge of units of measurement
- Select measurement techniques appropriate for given situation
- Match measurement tools to measurement requirements
- Determine degree of accuracy required for given situation
- Analyze implications of the degree of accuracy of various measurements

Apply statistical analysis skills

Key Indicators:

- Estimate probability using standard techniques and formulas
- Analyze software options available for statistical analysis
- Select software option most appropriate for given situation
- Analyze statistical data using selected software
- Make inferences or predictions based on data analysis
- Represent statistical data using tables, charts, and graphs

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Analyze critical data to guide work activities

Key Indicators:

- Identify critical data needed
- Determine the level of detail necessary for various situations according to prescribed procedures (including task analysis; procedural analysis; financial activities; personnel matters; customer contacts; noncompliance and violations; and/or deviations from normal operation of processes, equipment and instrumentation)
- Ensure that documentation is complete and error-free and provides valid and reliable evidence
- Ensure that documentation is in compliance with established procedures
- Analyze documentation to determine appropriate actions for specific situations

Utilize scheduling techniques to ensure that jobs are completed by the stated due date

Key Indicators:

- Develop schedules for equipment maintenance
- Develop schedules for materials production, handling, and distribution
- Develop meeting schedules
- Distribute schedules to all concerned personnel
- Implement schedules as planned
- Make changes in schedules as appropriate

Demonstrate knowledge of the economy and how it functions as a whole

Key Indicators:

- Analyze how individuals and societies make choices to satisfy wants with limited resources
- Analyze how factors of production (including land, labor, capital, and entrepreneurship) are used to produce goods and services
- Analyze how individuals and households exchange their resources for income in order to buy goods and services
- Analyze how individuals and business firms use resources to produce goods and services to generate revenue
- Identify the characteristics of command, market, and traditional economies
- Analyze how all levels of government assess taxes in order to provide services

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Demonstrate knowledge of the economy as a framework within which decisions are made by individuals and groups

Key Indicators:

- Determine opportunity costs and trade-offs
- Identify key individuals and groups that make economic decisions at the local, state, national, and international levels
- Identify the important roles that local, state, national, and international governments play in a global economy
- Characterize how government decisions affect individuals
- Identify how geographic factors affect the political and economic systems of other countries
- Analyze how national and international markets allocate goods and services
- Analyze how resources, goods, and services are exchanged in national and international markets
- Demonstrate knowledge of competition and how it affects national and international markets
- Demonstrate knowledge of supply and demand and how it affects national and international markets

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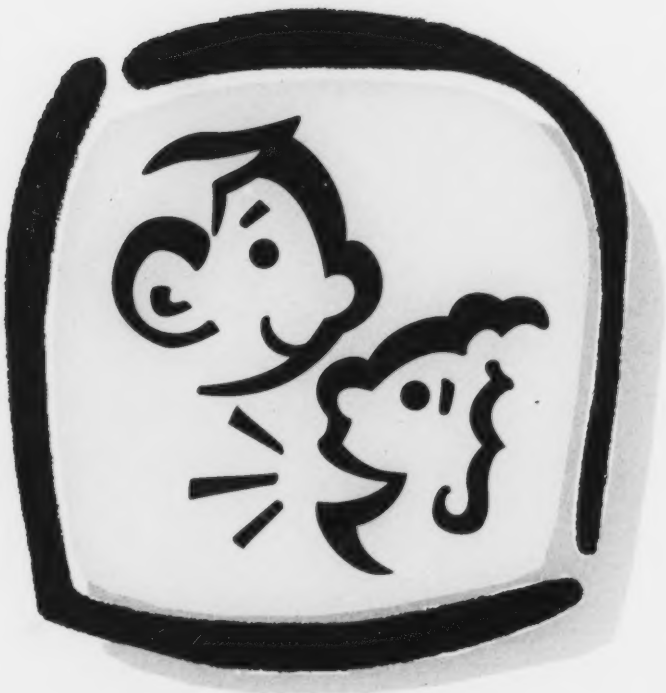
Communicating Effectively - Strand 2

Core ITAC



Expectation

Effective communication is essential to workplaces, communities, and families. Employees with positive communication skills contribute to organizational productivity, enhance interpersonal relationships with coworkers and clients, and create opportunities for promotion and advancement.

Competencies

- Apply basic communication skills
- Apply oral communication skills
- Apply written communication skills
- Apply technical writing skills
- Apply listening skills
- Apply demonstration/presentation skills
- Apply graphic communication skills
- Apply artistic communication skills
- Convey information through multimedia presentations
- Create graphs and charts
- Build interpersonal relationships

Scenario

The Chamber of Commerce in your city would like to develop materials to attract new businesses to the community. Your public relations firm has been hired to create promotional materials that highlight your community's resources, rich ethnic history, and workforce. Create these materials and present them to a variety of community members, including business and industry representatives, private citizens, and civic leaders.

Guiding Questions

- What communication tools should be used to convey this information to the target audiences?
- How will you use creative or artistic expression to communicate the information to the target audience?
- What historic and current events have contributed to the city's resources, ethnic diversity, and workforce?
- How will you work with community groups and representatives to build support for your promotional materials?

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Apply basic communication skills

Key Indicators:

- Guide communication activities using established rules for grammar, word usage, spelling, and sentence construction
- Select communication style appropriate to audience and situation
- Present messages in a form that assists recipient's understanding (e.g., speak and write clearly and concisely, write legibly)
- Locate needed information using communications reference tools (e.g., dictionary, thesaurus, style manual, word division guide)
- Interpret oral, written, and nonverbal messages
- Follow written and oral instructions
- Clarify messages received (e.g., through paraphrasing, questioning)
- Communicate basic messages in a language other than English

Apply oral communication skills

Key Indicators:

- Apply basic communication skills in communicating orally
- Use nonverbal techniques to reinforce the intended verbal message
- Support oral communication with creative attention-getters, analogies, examples, verbal illustrations, etc.
- Supplement oral communication with other forms of communication (including graphic, written, artistic)
- Demonstrate sensitivity to cultural diversity (e.g., accepted variations in distances between speakers, use of eye contact, meaning of gestures; bias-free language)
- Adjust delivery according to perceived reception

Apply written communication skills

Key Indicators:

- Apply basic communication skills in communicating in written form
- Organize information into the appropriate format in accordance with standard practices (including prewriting, drafting, proofreading, editing/revising, preparing final copy/publishing)
- Incorporate creative and original elements (e.g., unique writing style, content, layout) in the written product
- Supplement written communication with other forms of communication (including graphic, oral, artistic)
- Demonstrate sensitivity to cultural diversity
- Use technology (e.g., spelling checkers) to enhance accuracy

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Apply technical writing skills

Key Indicators:

- Apply basic communication skills
- Consider topic in relation to the audience and purpose
- Determine when graphics, charts, and sketches are needed to support and clarify text
- Present information in a clear and concise manner

Apply listening skills

Key Indicators:

- Identify major points of the message (including key information, directions, specific details)
- Determine real needs or goals by attending to both verbal and nonverbal messages
- Differentiate between facts, opinions, and feelings
- Document message using standard note-taking techniques
- Overcome communication barriers
- Clarify communication by rephrasing statements, asking questions, showing empathy, and interpreting both verbal and nonverbal information

Apply demonstration/presentation skills

Key Indicators:

- Apply basic communication skills in presenting a demonstration/presentation
- Select valid and reliable reference(s)
- Organize content based on purpose and audience
- Determine desirable format
- Incorporate creative and original elements into the demonstration/presentation
- Organize the components necessary to conduct a demonstration/presentation (including resources, equipment, handouts, graphics, advance organizers)
- Incorporate media that support the purpose of the demonstration/presentation (including projection equipment, computer software)
- Present the results of an investigation
- Demonstrate the operation of equipment or facilities and/or given techniques and procedures
- Communicate possible problems, processes, and solutions
- Demonstrate knowledge of the topic(s) to be communicated
- Use self-expression appropriate to the situation (including grooming, adjustment of behavior, expression of feelings and ideas)
- Convey information to audience according to accepted business communication practices
- Adjust communication according to audience feedback

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Apply graphic communication skills

Key Indicators:

- Apply basic communication skills in communicating through graphics
- Ensure that all information is accurate and complete
- Specify graphics needed to support presentations
- Communicate information using graphics in, print, poster, or transparency form
- Communicate information using slides prepared with presentation software
- Incorporate creative and original elements into graphics
- Employ effective design techniques in development of graphics (including space, lines, shading, shaping, symbols)
- Demonstrate sensitivity to cultural diversity

Apply artistic communication skills

Key Indicators:

- Apply basic communication skills in communicating artistically
- Participate in a wide variety of experiences that expose self to an appreciation of the arts disciplines—dance, music, theater, and the visual arts
- Analyze exemplary works through the relationship between artistic practices, products, and perspectives
- Interpret historical and modern artifacts
- Demonstrate artistic and creative techniques of production and performance
- Create an original artifact or performance that demonstrates an understanding of history and culture

Convey information through multimedia presentations

Key Indicators:

- Organize content based on purpose and audience
- Evaluate which set of procedures, tools, or equipment will produce the desired results
- Produce a presentation, including designing, creating, importing data and graphics, editing, formatting, and sequencing
- Operate multimedia equipment
- Apply problem-solving techniques to resolve problems encountered in the process of designing and implementing multimedia presentations

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Create graphs and charts

Key Indicators:

- Access sources of needed information
- Select data for inclusion
- Convert data into chosen graphical format
- Ensure that the results are correctly represented (including font, scale, size)
- Draw conclusions from information presented in graphs and charts

Build interpersonal relationships

Key Indicators:

- Demonstrate knowledge of the components of effective communication
- Relate to people of different ages, abilities, genders, cultures, and behavior styles
- Demonstrate caring, empathy, and appreciation for others
- Communicate personal feelings, needs, and ideas constructively
- Demonstrate effective listening skills
- Manage conflict and stress

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Applying Technology - Strand 3

Core ITAC

Expectation

Technology influences every work environment. To be effective in today's workplace, individuals must be able to use the tools of technology to improve productivity and efficiency. Employers seek individuals who have developed technological skills and who stay abreast of the continuously changing technological environment.

Competencies

- Demonstrate technological literacy
- Access/transmit information using electronic communication systems
- Demonstrate computer literacy
- Use database software in work-related situations
- Use spreadsheet software in work-related situations
- Use word-processing software in work-related situations

Scenario

You own a company that sells and maintains a wide variety of office equipment and computer systems. A small, family-owned business has asked you to develop a proposal for equipping its organization with the technology necessary to improve its productivity and customer service. Prepare a proposal with your recommendations, and present it to the owners of the business to persuade them to accept your proposal.

Guiding Questions

- How have technological innovations influenced workplace performance?
- What information do you need about this business to determine its technological needs?
- How will you obtain that information?
- What hardware, software, and online services does this business need?
- What communication tools will you need to persuade this business to accept your proposal?

Demonstrate technological literacy

Key Indicators:

- Demonstrate knowledge of the basic technology systems currently available (e.g., manufacturing technology, organizing and accessing information for technology)
- Analyze the interplay of technology with social issues, gender issues, ethics, law, and government
- Identify the uses of technology in industry, education, the political arena, and day-to-day consumer affairs
- Analyze the benefits and costs of new developments in technology
- Make decisions about the use of technology that improve performance in the workplace, in school, and in the home

Access/transmit information using electronic communication systems

Key Indicators:

- Determine which systems are most appropriate for given situations
- Transmit messages electronically
- Access information electronically (e.g., via information services, CD-ROMs, laser disks, videos, and the Internet)
- Conduct searches electronically
- Participate in electronic discussion groups

Demonstrate computer literacy

Key Indicators:

- Choose the hardware, software, and online services that will produce the desired results
- Comply with ethical standards in the acquisition, organization, analysis, and communication of information
- Keep informed of legal parameters regarding computers
- Provide routine maintenance and repair of computer hardware and software
- Write basic computer programs for given purposes

Use database software in work-related situations

Key Indicators:

- Demonstrate knowledge of the functions and features of database software
- Identify the type of data needed
- Determine the best database to aid in the collection, tabulation, synthesis, and evaluation of the particular data identified
- Locate needed operations information using software documentation or help functions
- Construct database for the specified purpose
- Access needed information from the database
- Select report design for presenting data

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Use spreadsheet software in work-related situations

Key Indicators:

- Demonstrate knowledge of the functions and features of spreadsheet software
- Identify the type of data needed
- Determine the best spreadsheet to aid in the collection, tabulation, synthesis, and evaluation of the identified data
- Locate needed operations information using software documentation or help functions
- Construct spreadsheet for the specified purpose
- Analyze data
- Interpret results

Use word-processing software in work-related situations

Key Indicators:

- Demonstrate knowledge of the functions and features of word-processing software
- Construct word-processed documents for the specified purpose
- Locate needed operations information using software documentation or help functions
- Integrate databases, spreadsheets, graphics, and desktop publishing files into word-processed documents
- Edit documents using available software features and functions

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Working Responsibly - Strand 4

Core ITAC

Expectation

Work organizations value employees who possess the ability to work with diverse groups of people and who are able to lead others toward the achievement of common goals. Individuals must demonstrate a positive work ethic—exhibiting honesty, initiative, and dependability. In addition, they should understand the importance of ethical conduct and the role of ethics in professional organizations and work environments.

Competencies

Demonstrate leadership

Contribute to teamwork

Choose ethical courses of action in all work assignments and personal interactions

Demonstrate the work ethic

Comply with the confidentiality requirements of workplace policies and procedures

Apply appropriate strategies for dealing with the differences associated with diversity (e.g., racial, ethnic, gender, educational, personality, social, and age)

Scenario

You are the director of human resources for a chain of retail stores. Lately there have been several incidents in which employees have treated customers rudely or unfairly because of the customers' racial or ethnic background. You have been asked to provide training for employees that will encourage an appreciation of diversity, positive relations with customers, and an understanding of the legal and economic implications of inappropriate behavior. Present the training plan to your company's management team for their approval.

Guiding Questions

- What are the benefits of multicultural diversity? What can business organizations do to support an appreciation of diversity?
- What are the contributions of various ethnic groups to businesses, communities, and society?
- What are the legal, social, and economic consequences of prejudicial or discriminatory actions for individuals, businesses, and communities?
- What laws prohibit discriminatory actions? In what context were these laws enacted?

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Demonstrate leadership

Key Indicators:

- Identify a variety of leadership strategies
- Demonstrate leadership qualities
- Distinguish between the uses of leadership and management
- Analyze the factors influencing choice of leadership strategy in a given situation
- Match leadership strategies to the given group situation
- Collaborate with others to accomplish goals

Contribute to teamwork

Key Indicators:

- Demonstrate sensitivity to cultural, gender, and generational differences (in communication, interpersonal skills, and learning preferences)
- Demonstrate concern for each team member and for team goals (e.g., provide encouragement, maintain a can-do attitude and common focus)
- Complete aspects of assigned tasks according to team-established procedures and within specific timelines
- Employ group process techniques to solve problems, make decisions, build consensus, resolve or manage conflicts, construct compromises, support self-expression, and bring forth new ideas and opinions
- Evaluate the team's efforts

Choose ethical courses of action in all work assignments and personal interactions

Key Indicators:

- Establish a personal code of ethics
- Ensure that personal code of ethics is consistent with the professional code of ethics of the chosen profession
- Identify strategies that strengthen desirable character traits (including honesty, integrity, compassion, empathy, justice)
- Identify consequences of unethical conduct
- Recognize conflict between personal/professional ethics and the ethics of others
- Demonstrate awareness of legal responsibilities (e.g., copyright laws, harassment, equity)
- Identify strategies for responding to the unethical actions of individuals and organizations

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Demonstrate the work ethic

Key Indicators:

- Exhibit desirable personal and professional attitudes and behaviors (including positive view of self and work, awareness of impact on others, responsibility, pride)
- Exhibit desirable personal and professional work habits and behaviors (including punctuality, regular attendance, quality performance, meeting or exceeding of job expectations, self-motivation, honesty)
- Determine own role within the company's mission
- Participate in required and voluntary professional development to benefit employer and self
- Improve performance for the benefit of employer and self
- Display a sense of personal responsibility for the welfare of the company and colleagues (including health, safety, environmental concerns)
- Distinguish between work ethics of various organizations, work groups, and cultures

Comply with the confidentiality requirements of workplace policies and procedures

Key Indicators:

- Identify types of confidential information (including mail and information about personnel, customers, company)
- Maintain records on the distribution of information using established format and procedures
- Provide information only to authorized personnel, whether transmitted physically or via technology
- Inspect returned materials for completeness
- Identify the consequences of a breach of confidentiality

Apply appropriate strategies for dealing with the differences associated with diversity (e.g., racial, ethnic, gender, educational, social and age)

Key Indicators:

- Recognize the differences associated with diversity and the implications of those differences
- Demonstrate effective interpersonal skills in working with others of different backgrounds
- Express feelings, actions, and ideas respectfully
- Identify appropriate strategies and solutions for dealing with cultural conflicts and differences
- Demonstrate respect for diverse international business practices and etiquette

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Planning and Managing a Career - Strand 5

Core ITAC

Expectation

Since work is a significant part of life, individuals need to be actively engaged in seeking a career that matches their interests, abilities, aptitudes, and skills. Career planning enhances the possibility that one's career path will lead to success and satisfaction in work. Employers seek individuals who know what they want from work and can effectively present their qualifications and skills through the job search process, including job applications and interviews. Throughout one's career, it is also important to seek continuous professional development opportunities.

Competencies

- Identify how personal interests, abilities, and skills relate to choosing a career
- Investigate career options
- Chart career using career-planning skills
- Demonstrate skills needed to enter or reenter the workforce
- Demonstrate job-keeping skills
- Upgrade career skills
- Explore opportunities to create a business

Scenario

You have just been granted an interview for a position in the career area of your choice. Assuming you have completed all education and training necessary for this career, prepare to discuss why you selected the career, your long-range career goals, the skills you will bring to the workplace, and your long-term plan for professional development. Following the interview, obtain feedback about your ability to portray your interest and qualifications.

Guiding Questions

- What should you consider when planning a career?
- What are the implications of selecting a nontraditional career?
- What skills are needed to be successful in this career? How can you obtain those skills?
- Where can you obtain information about various careers and career opportunities?
- What communication skills will you use to convey your interest in and qualifications for this career?

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Identify how personal interests, abilities, and skills relate to choosing a career

Key Indicators:

- Determine own interests and aptitudes
- Relate personal interests to academic and occupational skills
- Identify impact of abilities and skills on career development
- Identify how self-knowledge relates to making career choices

Investigate career options

Key Indicators:

- Identify career options, including self-employment and nontraditional careers
- Identify the range of available career information sources
- Research knowledge, abilities, and skills needed in each occupation using a variety of resources (e.g., handbooks, career materials, labor market information, computerized career-information delivery systems, and role models/mentors)
- Select careers that best match interests and aptitudes
- Analyze the impact of factors such as population, climate, employment trends, and geographic location on occupational choice
- Assess differences in the wages, benefits, annual incomes, cost of living, and job opportunities associated with selected career options
- Identify potential conflicts between interest/aptitudes and career choices
- Identify how career choices influence family, personal life, and lifestyle
- Assess labor market information pertaining to career options
- Explore future trends and occupations in the world of work

Chart career using career-planning skills

Key Indicators:

- Demonstrate use of career information
- Identify elements of career planning
- Summarize the educational requirements of various occupations
- Identify skills that apply to a variety of occupations
- Identify challenges that may interfere with individual career plan (e.g., gender issues, misinformation, expectations of others, and conditions of labor market)
- Identify short-term and long-term goals for achieving career plan
- Develop a career plan
- Showcase interests, aptitudes, and skills utilizing a portfolio
- Annually review/revise the individual career plan

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Demonstrate skills needed to enter or reenter the workforce

Key Indicators:

- Apply knowledge of personal abilities, interests, and skills to the seeking of employment regionally, nationally, and globally
- Develop job-getting tools (including résumés, letters of application, portfolios)
- Demonstrate job-getting skills (including locating acceptable jobs, interviewing, completing a job application, and interpreting an employee contract)
- Demonstrate skill in a second language if required for the position
- Maintain a portfolio demonstrating job competence and containing job-getting tools

Demonstrate job-keeping skills

Key Indicators:

- Demonstrate strong communication skills orally, in writing, or via computer
- Apply basic arithmetic and mathematics skills to job tasks
- Apply thinking skills to job tasks (including creative thinking, decision making, reasoning, problem solving, interpretation of information)
- Apply interpersonal skills in relating to others on the job
- Identify an awareness of employer expectations for the job
- Carryout job tasks in accordance with employer expectations
- Display positive work ethic

Upgrade career skills

Key Indicators:

- Identify personal and workplace changes that require upgrading of own skills
- Modify own career goals based on personal and workplace changes
- Analyze various education/training options for securing needed upgrading
- Identify professional development opportunities
- Participate in professional development activities
- Recognize need for lifelong upgrading of career skills

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Explore opportunities to create businesses

Key Indicators:

- Identify an unmet need or opportunity for provision of a good or service
- Identify potential target markets nationally and/or internationally
- Identify factors that contribute to the success or failure of a business
- Evaluate the costs and benefits of future opportunities (e.g., renovations, improvements, expansions, addition of new products or services, international trade opportunities)
- Evaluate entrepreneurship and intrapreneurship opportunities
- Identify components of a business plan, considering various factors for identified opportunities and marketing strategies (including population, climate, location, supply and demand, competition)

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Managing Resources - Strand 6

Core ITAC

Expectation

In high-performance workplaces, all individuals must effectively manage a variety of resources—personal, financial, and environmental. Individuals' ability to maintain good health, contribute to a safe work environment, and manage time not only enhances personal well-being, but fosters the success of the organization or business as well.

Competencies

Apply self-management processes in the workplace

Use reference materials to obtain information appropriate to a given problem, topic, or situation

Maintain/promote wellness

Determine the impact of government regulations and business/industry procedures on the performance of particular work functions

Implement safety procedures and programs

Support the provision of first aid in accordance with company policy and procedures

Manage work and family responsibilities for the well-being of self and others

Determine resources needed to produce a given product or provide a given service

Ensure the quality of products and services

Utilize an inventory control system to track supplies, materials, and equipment

Make informed financial decisions

Scenario

Your city has just experienced an outbreak of E.coli bacteria, which made a large percentage of the population ill. As a member of the city health department staff, your job is to analyze the potential causes of the outbreak and to educate the citizens and businesses in the community so as to prevent future outbreaks. Develop and present several communication tools, such as a 60-second television advertisement and a brochure, that convey your recommendations to prevent further contamination and illness.

Guiding Questions

- What food-handling and production practices contribute to E.coli contamination?
- What are the consequences of unsafe practices for individuals, businesses, and the community as a whole?
- What government regulations and business/industry policies impact the quality and safety of the foods we eat?
- How can individuals and families maintain good health and prevent E.coli contamination?

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Apply self-management processes in the workplace

Key Indicators:

- Develop a system for organizing work
- Apply time-management skills
- Apply anger-management skills
- Apply stress-management skills
- Arrange work environment based on the principles of ergonomics
- Maintain a work area conducive to productivity (e.g., neat, orderly)
- Manage resources to support achievement of goals

Use reference materials to obtain information appropriate to a given problem, topic, or situation

Key Indicators:

- Obtain needed technological and informational reference materials
- Collect information from selected references
- Evaluate the validity and reliability of the information obtained
- Organize information for use in problem solving, decision making, or communications
- Apply information to workplace situations

Maintain/promote wellness

Key Indicators:

- Recognize positive and negative influences on wellness (including social activities, sports, hobbies, environment, health, emotions, economics)
- Participate in the arts disciplines and/or extracurricular activities (including dance, music, theater, visual arts, sports) that promote wellness and balance within an individual
- Follow wellness principles that result in significant, measurable improvements in own overall health condition and the health condition of peer(s)
- Monitor health and health parameters
- Act on environmental issues that influence wellness

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Determine the impact of government regulations and business/industry procedures on the performance of particular job functions

Key Indicators:

- Identify the purpose of government regulations and their impact on the management of resources
- Differentiate among federal, state, and local regulations and local business and industry procedures
- Identify the various agencies involved in government oversight
- Identify which regulations or guidelines take priority in a given situation
- Locate information about the required process(es) for implementing regulations
- Comply with regulations in the handling of materials, services, resources, and/or work activities (including inspection or self-monitoring)

Implement safety procedures and programs

Key Indicators:

- Identify safety requirements
- Demonstrate knowledge of safety rules and guidelines
- Interpret safety signs and symbols
- Demonstrate desirable safety attitudes and habits
- Use safety equipment in accordance with established procedures
- Document results of safety procedures and programs

Support the provision of first aid in accordance with company policy and procedures

Key Indicators:

- Identify supplies and equipment needed in emergency situations
- Locate supplies and equipment needed in emergency situations
- Follow established procedures for the administration of first aid until official help arrives
- Analyze the impact of stress throughout an emergency situation
- Practice universal precautions during first aid procedures (including those related to blood-borne pathogens, confined spaces, emergency egress, fire safety, hearing conservation)

Manage work and family responsibilities for the well-being of self and others

Key Indicators:

- Explore the meaning of work and the meaning of family
- Analyze how work life is affected by families and how families are affected by work life
- Implement strategies for balancing work and family roles

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Determine resources needed to produce a given product or provide a service

Key Indicators:

- Identify the different types of resources involved in the production of a product or provision of a service (e.g., financial, human, material, equipment)
- Create a management plan for the allocation of financial resources to meet financial goals
- Plan for the appropriate allocation and use of materials and equipment
- Plan for the allocation and use of human resources
- Plan for the allocation and use of information and technology needed to make and support decisions
- Plan for the allocation and use of natural resources
- Plan for the allocation and use of space so as to make the best use of facilities for goal achievement

Ensure the quality of products and services

Key Indicators:

- Identify the importance of individual and organizational productivity in the workplace and how it affects the profitability of the business
- Determine the quality- and quantity-control standards and procedures required to produce a specific product or provide a specific service
- Inspect the production of the product or provision of the service to assure quality levels
- Monitor production of products and provision of services
- Select equipment and raw materials that will support quality in the process of producing a product or providing a service
- Interpret quantitative and qualitative records to identify problems and provide a basis for making decisions about the production of products and provision of services
- Provide appropriate documentation regarding the quality of products and services
- Identify corrective actions needed to improve the quality of products and services
- Create new methods for improving the quality of products and services

Utilize an inventory control system to track supplies, materials, and equipment

Key Indicators:

- Determine the factors, including regulations, that influence the type of control system used
- Develop an inventory system
- Maintain the inventory system
- Report the inventory results

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Make informed financial decisions

Key Indicators:

- Identify the need for personal financial management records
- Create a budget
- Evaluate the effectiveness of the budget
- Demonstrate knowledge of how credit affects personal/family finances
- Identify the steps to follow to avoid credit problems
- Make informed consumer choices in response to personal needs and wants
- Identify the factors that influence consumer decisions (e.g., advertisements, peer groups, price, location)
- Recognize the value of company benefits and the importance of retirement planning
- Identify the costs and benefits for individuals of various types of taxation at the local, state, and federal levels

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Academic Connections in Core ITAC

Academic Connections answer the question, "What knowledge and skills from the Ohio Compentency-Based Education (CBE) Models are essential to the achievement of the Core competencies?" The academic content represented in the ITAC includes the subject areas from six models:

The Arts

Mathematics

Social Studies

Language Arts

Foreign Language

Science

These connections were identified by relating the content of the competencies in the Core ITAC strands to essential content from the objectives in the Ohio CBE Models. ITAC key indicators for each competency were used to clarify the nature and specificity of the connection. Subject-matter experts in each academic area verified the connections.

The following chart is a summary of the percentages of connections for each model. For specific connections between the core competencies and objectives in each model, visit the following website: <www.cete.org/products>. This summary does not represent all possible opportunities for interdisciplinary curriculum development. Many other connections could be made during the instructional process through authentic projects or workplace situations that involve related content.

Academic Connections in Core ITAC

The chart below illustrates the relationship between the Core ITAC and the objectives in Ohio's Competency-Based Education (CBE) Models. Each column represents the percent of the total number of CBE objectives, PreK–12 grade, that are related to each core competency.

Core ITAC Competencies	Academic Models: Percent of Model Relating to Core ITAC					
	The Arts	Math	Social Studies	Language Arts	Foreign Language	Science
Strand 1 — Solving Problems and Thinking Skillfully						
1.1 Solve problems and make decisions in work-related situations	52%	16%	4%	24%	0%	54%
1.2 Read for information and understanding	5%	1%	19%	33%	5%	32%
1.3 Use observation skills to analyze work-related situations	27%	5%	1%	42%	2%	39%
1.4 Apply mathematical processes	0%	62%	1%	<1%	4%	24%
1.5 Apply measurement and spatial skills	0%	22%	1%	0%	4%	28%
1.6 Apply statistical analysis skills	<1%	9%	<1%	1%	0%	12%
1.7 Analyze critical data to guide work activities	5%	0%	1%	1%	0%	27%
1.8 Utilize scheduling techniques to ensure that jobs are completed by the stated due date	<1%	0%	0%	3%	0%	1%
1.9 Demonstrate knowledge of the economy and how it functions as a whole	6%	0%	6%	1%	2%	0%
1.10 Demonstrate knowledge of the economy as a framework within which decisions are made by individuals and groups	3%	2%	6%	1%	4%	0%
Strand 2 — Communicating Effectively						
2.1 Apply basic communication skills	79%	3%	1%	67%	50%	20%
2.2 Apply oral communication skills	14%	5%	0%	18%	37%	10%
2.3 Apply written communication skills	5%	2%	0%	29%	13%	9%
2.4 Apply technical writing skills	2%	0%	0%	1%	0%	5%
2.5 Apply listening skills	4%	0%	1%	21%	8%	9%
2.6 Apply demonstration/presentation skills	20%	<1%	0%	6%	7%	4%
2.7 Apply graphic communication skills	12%	9%	2%	4%	5%	5%
2.8 Apply artistic communication skills	96%	<1%	1%	27%	8%	3%
2.9 Convey information through multimedia presentation	13%	0%	0%	2%	1%	4%
2.10 Create graphs and charts	3%	10%	2%	4%	5%	6%
2.11 Build interpersonal relationships	4%	0%	4%	5%	11%	7%

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Core ITAC Competencies	Academic Models Percent of Model Relating to Core ITAC					
	The Arts	Math	Social Studies	Language Arts	Foreign Language	Science
Strand 3 — Applying Technology						
3.1 Demonstrate technological literacy	5%	1%	1%	0%	0%	8%
3.2 Access/transmit information using electronic communication systems	<1%	0%	0%	2%	11%	2%
3.3 Demonstrate computer literacy	4%	2%	0%	4%	3%	4%
3.4 Use database software in work-related situations	0%	0%	0%	<1%	0%	3%
3.5 Use spreadsheet software in work-related situations	0%	<1%	0%	0%	0%	2%
3.6 Use word-processing software in work-related situations	<1%	0%	0%	2%	2%	2%
Strand 4 — Working Responsibly						
4.1 Demonstrate leadership	0%	0%	2%	1%	0%	4%
4.2 Contribute to teamwork	20%	0%	5%	23%	4%	5%
4.3 Choose ethical courses of action in all work assignments and personal interactions	0%	0%	<1%	1%	0%	4%
4.4 Demonstrate the work ethic	<1%	0%	1%	13%	3%	4%
4.5 Comply with the confidentiality requirements of workplace policies and procedures	0%	0%	0%	<1%	0%	1%
4.6 Apply appropriate strategies for dealing with the differences associated with diversity (e.g., racial, ethnic, gender, educational, personality, social, and age)	20%	0%	8%	20%	8%	4%
Strand 5 — Planning and Managing a Career						
5.1 Identify how personal interests, abilities, and skills relate to choosing a career	8%	0%	1%	11%	2%	1%
5.2 Investigate career options	6%	0%	0%	<1%	3%	1%
5.3 Chart career using career-planning skills	2%	0%	0%	<1%	2%	1%
5.4 Demonstrate skills needed to enter or reenter the workforce	4%	0%	<1%	1%	5%	<1%
5.5 Demonstrate job-keeping skills	0%	0%	0%	8%	<1%	0%
5.6 Upgrade career skills	0%	0%	0%	0%	0%	0%
5.7 Explore opportunities to create businesses	2%	0%	3%	0%	1%	0%

Core ITAC Competencies	Academic Models: Percent of Model Relating to Core ITAC					
	The Arts	Math	Social Studies	Language Arts	Foreign Language	Science
Strand 6 — Managing Resources						
6.1 Apply self-management processes in the workplace	5%	0%	3%	8%	8%	3%
6.2 Use reference materials to obtain information appropriate to a given problem, topic, or situation	12%	0%	1%	7%	<1%	4%
6.3 Maintain/promote wellness	<1%	0%	0%	8%	1%	1%
6.4 Determine the impact of government regulations and business/industry procedures on the performance of particular work functions	0%	0%	4%	0%	0%	0%
6.5 Implement safety procedures and programs	12%	0%	0%	<1%	0%	3%
6.6 Support the provision of first aid in accordance with company policy and procedures	0%	0%	0%	0%	0%	0%
6.7 Manage work and family responsibilities for the well-being of self and others	0%	0%	0%	<1%	0%	<1%
6.8 Determine resources needed to produce a given product or provide a given service	11%	0%	6%	2%	0%	1%
6.9 Ensure the quality of products and services	22%	0%	0%	8%	0%	<1%
6.10 Utilize an inventory control system to track supplies, materials, and equipment	0%	0%	0%	<1%	0%	<1%
6.11 Make informed financial decisions	0%	0%	2%	<1%	0%	0%

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Core ITAC Acknowledgments

The Vocational Instructional Materials Laboratory extends thanks and appreciation to the many representatives of business, industry, labor, and community organizations who contributed their time and expertise to the identification and verification of competencies.

The following panel participants verified the technical and academic competencies in the Core ITAC:

Laura Berk, The Center for Manufacturing Excellence, Toledo, Ohio
Kay Briggs, Coalition of Neighborhoods, Cincinnati, Ohio
Walter R. Cates, Sr., Main Street Business Association, Columbus, Ohio
Cap Clegg, Columbus Financial Concepts, Dublin, Ohio
Randy Deatherage, Agnew Farm Equipment, Youngstown, Ohio
Timothy A. Ely, Beacon Electric, Cincinnati, Ohio
Diane Findley, RN, Paul E. Detty MD Inc., Lancaster, Ohio
Sheila Kane, The Andersons General Store, Columbus, Ohio
Keith Meske, Educable TV 25, Columbus, Ohio
Sandy O'Connor, Clark County Dept. of Human Services, Springfield, Ohio
Joyce E. Odor, Columbus Public Schools, Columbus, Ohio
James H. Orsborn, American Electric Power, Columbus, Ohio
Robert A. Osterling, Hy-Level Industries, Cleveland, Ohio
Charlie Pinter, Kroger, Gahanna, Ohio
Scott J. Wallace, Red Roof Inns, Inc., Hilliard, Ohio
Van S. White, Human Resources Consultant, Cincinnati, Ohio
Morris Williams, Coalition of Neighborhoods, Cincinnati, Ohio

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Virginia Ballinger, Ohio Department of Education, Columbus, Ohio
Heather Boggs, Ohio Department of Education, Columbus, Ohio
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Denise P. Clapp, Hilliard Davidson High School, Hilliard, Ohio
Carmen R. Giebelhaus, Ohio Department of Education, Columbus, Ohio
Karen P. Heath, Ohio Department of Education, Columbus, Ohio
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Betty Kulich, Fort Hayes Metro Education Center, Columbus, Ohio
Jerry Mahl, EHOVE Career Center, Milan, Ohio
Kent J. Minor, Ohio Department of Education, Columbus, Ohio
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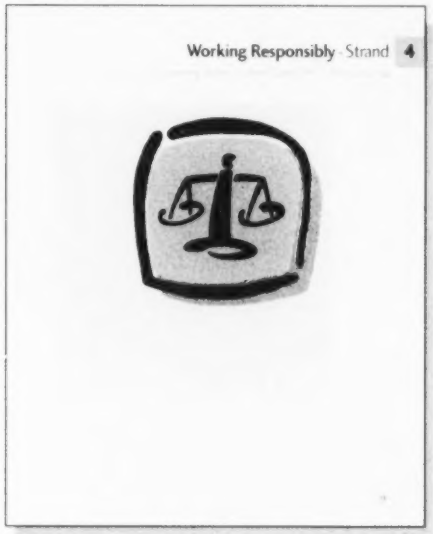
Industrial & Engineering Systems Career Cluster ITAC

Manufacturing Sub-Cluster

Components of Career Cluster ITACs

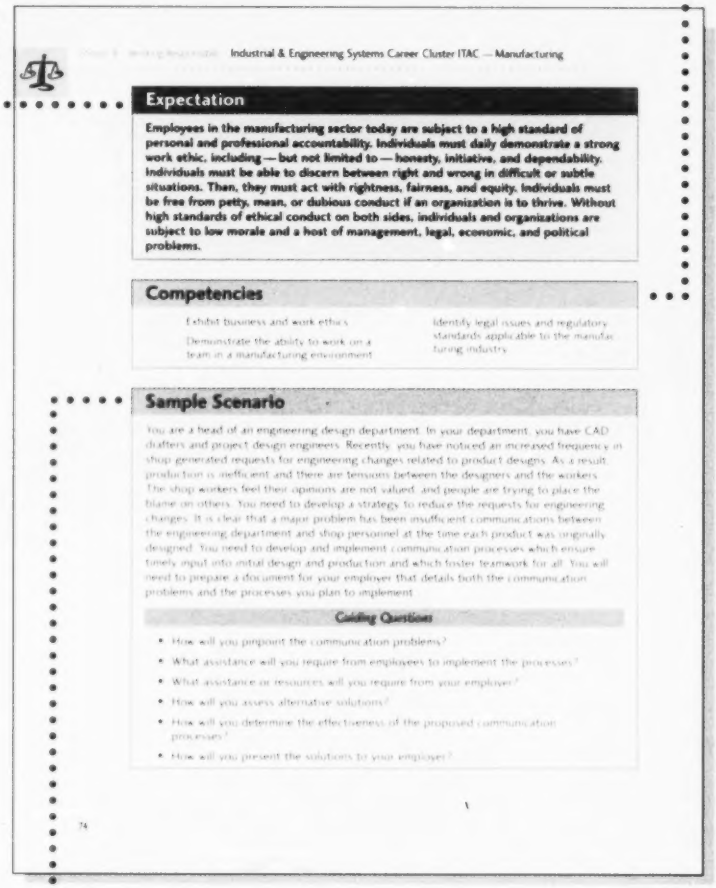
Career Clusters:
- Arts & Communications
- Business & Management
- Industrial & Engineering Systems
- Human Resources/Services
- Environmental & Agricultural Systems
- Health Services



Each strand in a Career Cluster ITAC has an introduction page which identifies the strand (in words and by icon) and the career cluster. These pages also appear in the Core ITAC.

Expectation – a statement of desired workplace behaviors and their importance in the world of work.

Competencies – observable and measurable knowledge, skills, and attitudes essential to achievement of the expectation.


Industrial & Engineering Systems Career Cluster ITAC — Manufacturing

Expectation

Employees in the manufacturing sector today are subject to a high standard of personal and professional accountability. Individuals must daily demonstrate a strong work ethic, including — but not limited to — honesty, initiative, and dependability. Individuals must be able to discern between right and wrong in difficult or subtle situations. Then, they must act with rightness, fairness, and equity. Individuals must be free from petty, mean, or dubious conduct if an organization is to thrive. Without high standards of ethical conduct on both sides, individuals and organizations are subject to low morale and a host of management, legal, economic, and political problems.

Competencies

Exhibit business and work ethics

Demonstrate the ability to work on a team in a manufacturing environment

Identify legal issues and regulatory standards applicable to the manufacturing industry

Sample Scenario

You are a head of an engineering design department. In your department, you have CAD drafters and project design engineers. Recently, you have noticed an increased frequency in shop generated requests for engineering changes related to product designs. As a result, production is inefficient and there are tensions between the designers and the workers. The shop workers feel their opinions are not valued, and people are trying to place the blame on others. You need to develop a strategy to reduce the requests for engineering changes. It is clear that a major problem has been insufficient communications between the engineering department and shop personnel at the time each product was originally designed. You need to develop and implement communication processes which ensure timely input into initial design and production and which foster teamwork for all. You will need to prepare a document for your employer that details both the communication problems and the processes you plan to implement.

Guiding Questions

- How will you pinpoint the communication problems?
- What assistance will you require from employees to implement the processes?
- What assistance or resources will you require from your employer?
- How will you assess alternative solutions?
- How will you determine the effectiveness of the proposed communication processes?
- How will you present the solutions to your employer?

Sample Scenario – a real-life workplace situation requiring learners to apply the knowledge and skills reflected in the strand competencies.

Sample Guiding Questions – targeted questions to use in focusing learners' attention on knowledge and skills covered in the scenario.

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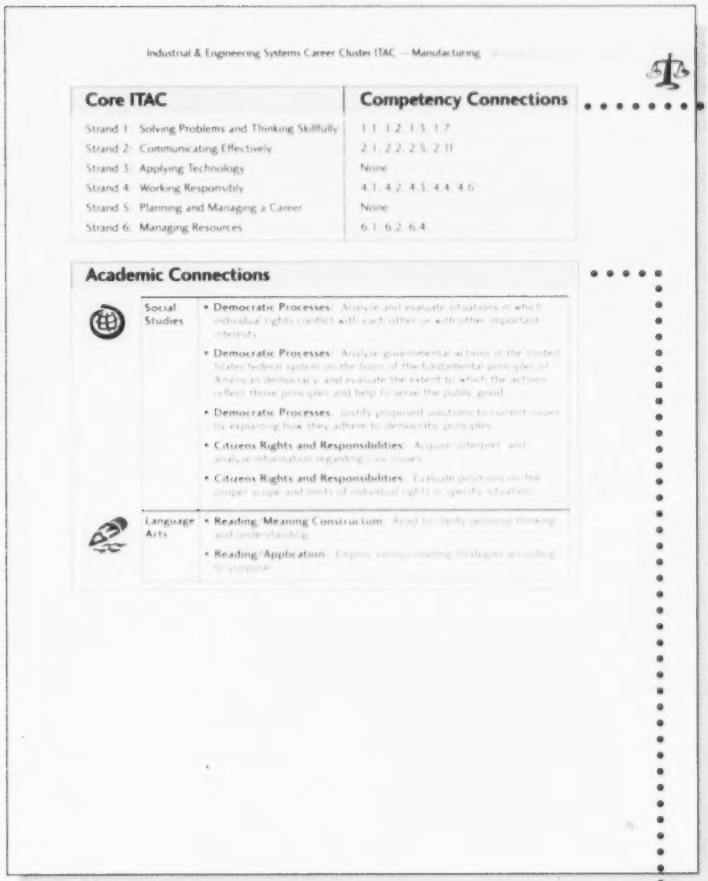
Connections to Core ITAC Competencies – a list, by number, of key competencies in Core ITAC that relate to and/or reinforce the competencies in the given strand and cluster.



Industrial & Engineering Systems Career Cluster ITAC — Manufacturing

Core ITAC	Competency Connections
Strand 1: Solving Problems and Thinking Skillfully	1.1, 1.2, 1.3, 1.7
Strand 2: Communicating Effectively	2.1, 2.2, 2.5, 2.11
Strand 3: Applying Technology	None
Strand 4: Working Responsibly	4.1, 4.2, 4.3, 4.4, 4.6
Strand 5: Planning and Managing a Career	None
Strand 6: Managing Resources	6.1, 6.2, 6.4

Academic Connections

Social Studies	• **Democratic Processes**: Analyze and evaluate situations in which individual rights conflict with each other or with other important interests. • **Democratic Processes**: Analyze governmental actions in the United States federal system on the basis of the fundamental principles of American democracy, and evaluate the extent to which the actions reflect those principles and help to serve the public good. • **Democratic Processes**: Justify proposed solutions to current issues by explaining how they adhere to democratic principles. • **Citizens Rights and Responsibilities**: Acquire, interpret, and analyze information regarding civic issues. • **Citizens Rights and Responsibilities**: Evaluate positions on the proper scope and limits of individual rights in specific situations.
Language Arts	• **Reading: Meaning Construction**: Read accurately, personal thinking, and understanding. • **Reading: Application**: Explain various reading strategies according to purpose.

Connections to Academic Models – a list of objectives from Ohio's Competency-Based Education Models, grades 9–12, that relate to and/or reinforce the competencies in the given strand and cluster. Each academic area is represented by an icon.

Industrial & Engineering Systems Career Cluster ITAC — Manufacturing

Competencies & Key Indicators

Exhibit business and work ethics

Key indicators

Demonstrate the ability to work on a team in a manufacturing environment

Key indicators

Identify legal issues and regulatory standards applicable to the manufacturing industry

Key indicators

Pages following the overview list each competency with its key indicators. Key indicators describe significant elements of competency performance.

Connections to Ohio's Proficiency Tests and ACT Work Keys® – a crosswalk between ITACs (core, cluster, specialization) and assessments that reflect student exit outcomes.

The Arts

Mathematics

Social Studies

Language Arts

Foreign Language

Science

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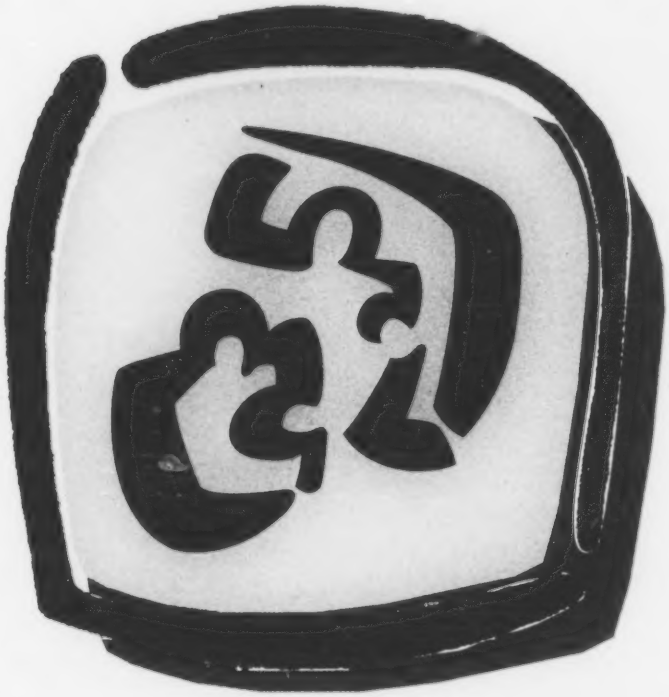
Solving Problems and Thinking Skillfully - Strand 1

Industrial & Engineering Systems Career Cluster ITAC — Manufacturing



Expectation

All individuals, regardless of career choice, must be able to think for themselves; initiate action on their own; and direct, modify, and assess their own work. Employers seek lifelong learners who can locate and use information. The following competencies — focusing on manufacturing processes, applications, trends, and practices — specify the knowledge, skills, and attitudes needed to develop the capacity to assess problems and situations, anticipate what might happen next, and continuously search for creative solutions.

Competencies

- Analyze manufacturing processes
- Analyze trends and issues in the manufacturing industry
- Demonstrate knowledge regarding quality-assurance systems
- Demonstrate knowledge of basic electrical and electronics theory
- Measure voltage, current, resistance, charge, and load using electrical test equipment
- Demonstrate knowledge of basic hydraulic/pneumatic systems
- Demonstrate knowledge of flow concepts
- Demonstrate knowledge of welding procedures for metals and plastics
- Demonstrate knowledge of material-joining procedures
- Demonstrate knowledge of machining procedures for metals and plastics
- Demonstrate knowledge of the applications of basic mechanical physics
- Demonstrate knowledge of plastics processing/compounding

Sample Scenario

You are an industrial engineer in a manufacturing company that produces engines. As part of a fast-paced assembly line, you need to figure a way to lift 75-pound castings — which are about 1' in length, width, and height — off of skids to a 29"-high workbench. The castings need to be lifted at a minimum frequency of 2 per minute to maintain desired production flow. Overhead obstructions prevent the use of ceiling-mounted hoist mechanisms. Any device(s) for lifting must be portable to allow flexibility at the workstation. Propose a system and device(s) for lifting the castings. In 2 weeks, you will need to present your proposed solution and rationale to the manufacturing team responsible for this assembly line.

Guiding Questions

- What do you need to know about mechanical physics to propose an efficient and effective system?
- What criteria will you have for the system and for selecting or building the device(s)?
- What do you need to know from the potential users of the system and device(s)?
- What devices may already be on the market to do this task? How will you find out about them?
- How will you present your proposed solution at the meeting? Why?

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Core ITAC	Competency Connections
Strand 1: Solving Problems and Thinking Skillfully	1.1, 1.2, 1.3,1.7
Strand 2: Communicating Effectively	None
Strand 3: Applying Technology	3.1, 3.3
Strand 4: Working Responsibly	None
Strand 5: Planning and Managing a Career	None
Strand 6: Managing Resources	6.2, 6.4, 6.8, 6.9

Academic Connections

Math	• **Patterns, Relations, and Functions:** Model real-world phenomena with polynomial and exponential functions • **Patterns, Relations, and Functions:** Describe the general characteristics of polynomial functions, and use them in problem-solving situations • **Algebra:** Describe problem situations by using and relating numerical, symbolic, and graphical representations • **Algebra:** Develop graphical techniques of solution for problem situations involving functions
Social Studies	• **American Heritage:** Identify significant developments in history, and gauge their impact on subsequent events • **American Heritage:** Identify significant individuals and groups in history, gauge their impact on specific historical events, and assess how they came to have such influence • **People in Societies:** Analyze the social and economic impact of the transformation from an agrarian, rural society to an industrialized, urban society • **People in Societies:** Analyze the economic and social impact of the transformation from an industrialized, urban society to an informational, suburban society • **Decision Making and Resources:** Explain the reasons for the rise of labor organizations between 1815 and 1919, and describe their impact on the economic development of the United States • **Decision Making and Resources:** Explain and evaluate the effects of inflation and unemployment in an economy • **Decision Making and Resources:** Identify the external benefits and costs of economic activities • **Decision Making and Resources:** Investigate factors that influence the supply of and the demand for resources, goods, and services

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Academic Connections

Language Arts	• **Reading/Structure:** Develop and use an increasingly sophisticated vocabulary gained through context • **Reading/Meaning Construction:** Confirm and extend meaning in reading by researching new concepts and facts • **Reading/Application:** Employ various reading strategies according to purpose
Science	• **Scientific Inquiry:** Check the appropriateness and accuracy of measures and computations using various strategies (e.g., estimations, unit analysis, determination of significant figures) • **Scientific Inquiry:** Utilize appropriate units for counts and measures • **Scientific Inquiry:** Trace the development (e.g., history, controversy, and ramifications) of various theories, focusing on supporting evidence and modification with new evidence • **Scientific Inquiry:** Observe and document events and characteristics of complex systems • **Scientific Knowledge:** Investigate estimates and measurements of a wide range of distances and rates of change • **Scientific Knowledge:** Investigate physical and chemical changes in living and non-living systems (e.g., photosynthesis, weathering processes, glaciation, thermal effects on materials, energy cells) • **Scientific Knowledge:** Formulate descriptions of the impacts of various forms of mechanical and electromagnetic waves on various organisms and objects • **Scientific Knowledge:** Formulate explanations and representations of the production, transmission, and conservation of energy in biological and physical systems (e.g., weather, volcanism, earthquakes, electricity, magnetism, cellular respiration) • **Scientific Knowledge:** Formulate models and hypotheses about patterns in the natural world (e.g., social behavior, molecular structure, energy transformation, entropy, randomness, aging, chaos, hormonal cycles) • **Scientific Knowledge:** Formulate estimations for the range of energies within and between various phenomena (e.g., thermal, electromagnetic, thermonuclear, chemical, electrical) • **Scientific Knowledge:** Formulate explanations for the historical development of descriptions of motions, interactions, and transformations of matter and energy (e.g., classical Newtonian mechanics, special and general relativity, chaos) • **Scientific Knowledge:** Formulate hypotheses and models that may account for observable events (e.g., electricity and magnetism, gravitation, atoms, bonding, chemical reactions, quantum effects, energy flow in biological systems, predator-prey relationships)

Academic Connections

Science *(cont.)*	• **Scientific Knowledge:** Formulate specific cases of limitations and possible exceptions of theories and principles regarding the interactions of moving objects and organisms (e.g., fluid flow in vessels, motion near the speed of light, Heisenberg Uncertainty Principle, meteorological prediction, local variation and diversity, earthquake prediction, energy transportation in cellular respiration) • **Conditions for Learning Science:** Investigate social issues with a scientific perspective (e.g., human rights, wellness, economics, futurism, environmental ethics) • **Applications for Science Learning:** Do simple troubleshooting on common electrical and mechanical systems, identifying and eliminating possible causes of malfunctions

Competencies & Key Indicators

Analyze manufacturing processes

Key Indicators:

- Identify types of manufacturing processes
- Outline the process of manufacturing, from identifying customer need to producing a quality product
- Analyze factors related to manufacturing (e.g., economic, labor, material quality and availability, environmental)
- Investigate historical influences on the manufacturing process (e.g., the Industrial Revolution, the labor movement, the high-performance workplace)

Analyze trends and issues in the manufacturing industry

Key Indicators:

- Analyze economic trends that affect manufacturing
- Keep up-to-date regarding technology in tools, equipment, and operations
- Analyze environmental and community factors related to manufacturing
- Analyze productivity issues related to manufacturing (e.g., scrap, employee productivity, quality) and their effect on profitability
- Analyze how changes in demographics influence the labor market

Demonstrate knowledge of quality systems

Key Indicators:

- Identify historical influences on quality in manufacturing
- Identify types of quality-assurance procedures (e.g., SPC, ISO 9000, TQM)
- Identify how quality-assurance procedures contribute to high-performance workplaces

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Demonstrate knowledge of basic electrical and electronics theory

Key Indicators:

- Identify how electricity and electronics are used in manufacturing processes
- Demonstrate knowledge of scientific laws related to electricity
- Demonstrate knowledge of uses of series, parallel, and combination circuits
- Differentiate between AC and DC terms and applications
- Interpret schematic drawings and blueprints
- Demonstrate knowledge of how to install power and control circuits
- Demonstrate knowledge of the functions and applications of diodes and transistors
- Demonstrate knowledge of the characteristics and operation of digital and logic circuits
- Demonstrate knowledge of local codes and National Electrical Code (NEC)®
- Identify types and uses of transformers

Measure voltage, current, resistance, charge, and load using electrical test equipment

Key Indicators:

- Comply with safety procedures established for the use of testing equipment
- Demonstrate knowledge of how to use electrical testing equipment
- Select appropriate electrical testing equipment to test for voltage, current, resistance, charge, and load
- Measure current using a clamp-on ammeter
- Measure voltage, current, and resistance using a volt-ohm-multimeter (VOM)
- Check polarity using an outlet tester

Demonstrate knowledge of basic hydraulic/pneumatic systems

Key Indicators:

- Identify how hydraulic/pneumatic systems are used in the processes of manufacturing
- Identify basic hydraulic/pneumatic systems and components
- Interpret circuit diagrams (e.g., hydraulic, pneumatic)
- Identify connectors (e.g., hoses, fittings, tubes)

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Demonstrate knowledge of flow concepts

Key Indicators:

- Identify how flow concepts are used in the processes of manufacturing
- Identify types of fluids (e.g., air, water, oil)
- Identify properties of fluids (e.g., pressure, flow)
- Relate scientific principles to fluid flow (e.g., Pascal's law, Boyle's law, Bernoulli's equation)

Demonstrate knowledge of welding procedures for metals and plastics

Key Indicators:

- Identify how welding procedures are used in the processes of manufacturing
- Identify basic welding joints
- Identify the welding procedures specified for a given job
- Identify various welding processes
- Interpret basic welding symbols and their components
- Identify the purpose of the welding fixtures for a given production process
- Identify characteristics of quality welds

Demonstrate knowledge of material-joining procedures

Key Indicators:

- Identify how material joining procedures are used in the processes of manufacturing
- Identify compatibility of materials
- Identify types of bonds (e.g., chemical, thermal, mechanical)
- Identify types of fasteners (e.g., nuts, bolts, rivets)
- Identify grades of fasteners

Demonstrate knowledge of machining procedures for metals and plastics

Key Indicators:

- Demonstrate knowledge of how turning procedures are used in manufacturing processes
- Demonstrate knowledge of how milling procedures are used in manufacturing processes
- Demonstrate knowledge of computer numerical control (CNC) machining operations
- Demonstrate knowledge of electrical discharge machines (EDM) operations and procedures (carbon and wire type)
- Demonstrate knowledge of surface grinding procedures used in manufacturing processes
- Identify the process for calculating feeds and speeds
- Demonstrate knowledge of specialized processes (e.g., broaching, gear cutting, thread cutting)
- Identify types of tooling (e.g., high-speed steel (HSS), carbide, ceramic)
- Demonstrate knowledge of drilling procedures used in manufacturing processes
- Select process appropriate for specific materials (e.g., hardened, nonhardened, heat-treated)

Demonstrate knowledge of the applications of basic mechanical physics

Key Indicators:

- Identify how mechanical physics is used in the processes of manufacturing
- Differentiate between simple machines and their functions (e.g., pulleys and levers)
- Analyze kinetic energy
- Demonstrate knowledge of scientific laws associated with mechanical physics
- Identify variables that affect mechanical physics (e.g., temperature, vibrations, stresses, forces)

Demonstrate knowledge of plastics processing/ compounding

Key Indicators:

- Identify how plastics processing/compounding is used in the processes of manufacturing
- Identify materials (e.g., thermoset, thermoplastic)
- Identify processes (e.g., injection-molding, blow-molding, extrusion)
- Select applications and materials appropriate for specified processes

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Communicating Effectively - Strand 2

Industrial & Engineering Systems Career Cluster ITAC — Manufacturing

Expectation

Effective communication is essential to workplaces, communities, and families. In the manufacturing environment, there exists a specialized system of communication that one must understand to be successful. Employees with strong communication skills contribute to organizational productivity, enhance interpersonal relationships with coworkers and clients, and create opportunities for promotion and advancement.

Competencies

- Respond to customer needs
- Prepare documentation
- Communicate using telecommunications tools
- Interpret blueprints, schematics, and diagrams

Sample Scenario

You are working as a quality-control supervisor overseeing production of a wide variety of small vacuum pumps. The company has frequently hired English- and Spanish-speaking line workers. Because of the variety of pumps being produced, assembly procedures are frequently changing. You find that the new workers have difficulty following oral instructions for assembling the pumps. You have decided that you need a new method of communicating the proper assembly processes to the workers. With the consent of your employer, you have agreed to develop and implement a plan to accomplish improved communications. Because communication is a problem for other production units in the company as well, your employer wants you to present your plan and results to other supervisors for possible companywide implementation.

Guiding Questions

- What resources do you have to help you devise the plan?
- How might you use teams effectively?
- How will you determine the training needs for the new workers?
- What communication tools and technologies may be useful for helping workers assemble the pumps properly?
- How will you evaluate the implementation of the plan?

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Core ITAC	Competency Connections
Strand 1: Solving Problems and Thinking Skillfully	1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7
Strand 2: Communicating Effectively	2.1, 2.2, 2.3, 2.5, 2.11
Strand 3: Applying Technology	3.1, 3.2, 3.3
Strand 4: Working Responsibly	4.1, 4.3, 4.4, 4.5, 4.6
Strand 5: Planning and Managing a Career	None
Strand 6: Managing Resources	6.1, 6.5, 6.6

Academic Connections

Math	• **Geometry:** Create and interpret drawings of three-dimensional objects • **Geometry:** Represent problem situations with geometric models, and apply properties of figures • **Algebra:** Describe problem situations by using and relating numerical, symbolic, and graphical representations • **Algebra:** Determine slope, midpoint, and distance • **Algebra:** Describe geometric situations and phenomena using variables, equations, and functions • **Algebra:** Symbolize transformations of figures and graphs

Language Arts	• **Reading/Meaning Construction:** Read to clarify personal thinking and understanding • **Reading/Application:** Employ various reading strategies according to purpose • **Writing/Structure:** Clarify word choice according to audience, topic, and purpose • **Writing/Structure:** Evaluate and revise writing to focus on such things as audience, tone, and purpose • **Oral Communication/Meaning Construction:** Prepare and deliver a formal speech/presentation • **Oral Communication/Meaning Construction:** Assess needs of audience members, adjusting language and presentation according to their understanding • **Oral Communication/Application:** Use oral communication for a variety of purposes and audiences

Foreign Language	• **Cultural Knowledge:** Interact in a variety of cultural contexts that reflect both peer-group and adult activities of the target culture(s) using appropriate verbal and non-verbal language • **Cultural Knowledge:** Develop sensitivity to cultural differences

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Academic Connections

Science	• **Scientific Inquiry:** Translate information from and represent information in various forms with equal ease (e.g., tables, charts, graphs, diagrams, geometric figures) • **Scientific Inquiry:** Make and read scale drawings, maps, models, and other representations to aid planning and understanding

Competencies & Key Indicators

Respond to customer needs

Key Indicators:

- Recognize the importance of all customers to business
- Demonstrate knowledge of the relationship between meeting customer needs and profitability
- Interact with customers and vendors in a professional manner (prompt, friendly, courteous, helpful, knowledgeable, understandable, ethical, accurate)
- Follow through on goals, objectives, and commitments made to customers and vendors (deadlines, delivery specifications)
- Deliver formal and informal presentations to customers

Prepare documentation

Key Indicators:

- Identify types of reports (e.g., quality-control, shift turnover, preventive maintenance, schedules)
- Complete reports in accordance with established standards (e.g., completely, legibly, neatly, accurately, in a timely manner)
- File reports with appropriate personnel

Communicate using telecommunications tools

Key Indicators:

- Identify company policies regarding use of telecommunications tools (telephones, answering machine, voice mail, e-mail, teleconferencing systems, fax machines, Internet, pagers)
- Operate telecommunications equipment in accordance with company policy
- Communicate via telephones, voice mail, e-mail, teleconferencing systems, faxes, Internet, pagers
- Keep up-to-date concerning new and emerging communication technologies
- Take complete and accurate telephone messages
- Give complete and accurate telephone messages
- Follow established telephone etiquette

Interpret blueprints, schematics, and diagrams

Key Indicators:

- Identify established procedures for interpreting manufacturing blueprints, schematics, and diagrams
- Interpret dimensions, symbols, types of lines, views, and scales
- Determine tolerances associated with dimensions
- Make spatial interpretation of various three-dimensional forms for two-dimensional drawings
- Apply basic algebraic procedures and geometric concepts to blueprint reading
- Work within established industry tolerance parameters as defined by blueprints, schematics, and diagrams

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Applying Technology - Strand 3

Industrial & Engineering Systems Career Cluster ITAC — Manufacturing

Expectation

Technological advances influence rapid changes in technology and, in turn, to the processes and materials of manufacturing which have a direct impact on and to the skills of those who must understand and work within that setting. To be effective in today's workplace, individuals must be able to function across a range of technology and practice innovative applications of this technology. Employers seek individuals who have developed technological skills and who stay abreast of the continuously changing technological environment.

Competencies

- Analyze the role of technology in manufacturing
- Follow established procedures for using common hand tools
- Demonstrate use of basic measuring tools
- Operate power tools and stationary equipment (e.g., drill press, bench grinder, disc sander)
- Perform oxyacetylene welding, brazing, and cutting operations
- Perform soldering operations
- Cut metals (e.g., metals, plastics)
- Test materials for type and quality

Sample Scenario

You are a tool and die worker for a machine tooling company. You have been assigned to work with the marketing division to create a series of models that demonstrate the quality of cutting capabilities of your company's tooling line — drills, taps, counterboring tools, countersinking tools, and chamfering tools. These models will be used as part of a trade show display along with the tools that made them. In order to show the quality of cuts, these models must be made to reveal the sectioned details of the holes. In addition, the models need to reveal the capabilities of the tools on a variety of materials (aluminum, steel, etc.). You will need to have your models approved by your employer before the display at the trade show.

Guiding Questions

- What supplies and tools are required?
- What do you need to know about using the tools?
- How will you determine the size of the model(s)?
- How will you evaluate the quality of the models?

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Core ITAC	Competency Connections
Strand 1: Solving Problems and Thinking Skillfully	1.1, 1.2, 1.4, 1.5
Strand 2: Communicating Effectively	None
Strand 3: Applying Technology	3.1
Strand 4: Working Responsibly	4.1, 4.3, 4.4
Strand 5: Planning and Managing a Career	None
Strand 6: Managing Resources	6.1, 6.2, 6.5, 6.8, 6.9

Academic Connections

Math	• **Geometry:** Represent problem situations with geometric models, and apply properties of figures • **Geometry:** Demonstrate an understanding of angles and parallel and perpendicular lines • **Algebra:** Describe problem situations by using and relating numerical, symbolic, and graphical representations
Science	• **Scientific Inquiry:** Check the appropriateness and accuracy of measures and computations using various strategies (e.g., estimations, unit analysis, determination of significant figures) • **Scientific Inquiry:** Document potentially hazardous conditions and associated risks in selected homes and public areas • **Scientific Knowledge:** Investigate physical and chemical changes in living and non-living systems (e.g., photosynthesis, weathering processes, glaciation, thermal effects on materials, energy cells) • **Scientific Knowledge:** Formulate interpretations of the structure, function, and diversity in a variety of organisms and physical systems (e.g., mutation, global cataclysms, continental drift, particles) • **Scientific Knowledge:** Formulate interpretations of the relationship between energy exchange and the interfaces between components within systems • **Scientific Knowledge:** Formulate estimations for the range of energies within and between various phenomena (e.g., thermal, electromagnetic, thermonuclear, chemical, electrical) • **Conditions for Learning Science:** Perform and repeat investigations to verify data, determine regularity, and reduce the impact of experimental error • **Applications for Science Learning:** Analyze the contributions of advances in technology through history to own everyday life

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Competencies & Key Indicators

Analyze the role of technology in manufacturing

Key Indicators:

- Demonstrate knowledge of technology trends
- Identify technological advancements and the way they have influenced manufacturing processes
- Analyze the costs and benefits of technological innovations

Follow established procedures for using common hand tools

Key Indicators:

- Identify tools and their uses (impact, cutting, shaping, gripping, holding) in manufacturing processes
- Select tools appropriate for given task
- Inspect tools prior to each use
- Apply established safety procedures for given tool
- Perform specified task with given tool
- Maintain tools
- Store tools

Demonstrate use of basic measuring tools

Key Indicators:

- Identify measuring tools and their functions in manufacturing processes
- Demonstrate knowledge of the use, care, and maintenance of given tools
- Select measuring tools appropriate for given task
- Measure inside/outside diameters and depths using precision measuring tools with vernier scales
- Perform linear measurements using various measuring tools (e.g., micrometers, scales, calipers)
- Perform basic math functions in relation to measurement tasks

Operate power tools and stationary equipment (e.g., drill press, bench grinder, disc sander)

Key Indicators:

- Identify types of power tools and stationary equipment and their functions in manufacturing processes
- Select power tool and stationary equipment appropriate for given task
- Inspect power tools and stationary equipment
- Identify established policies and procedures for operating power tools and stationary equipment
- Apply established safety procedures
- Maintain power tools and stationary equipment
- Store tools and accessories in designated area

Perform oxyacetylene welding, brazing, and cutting operations

Key Indicators:

- Select proper type of fire extinguisher and safety equipment for welding processes
- Handle compressed gas cylinders in accordance with established safety procedures
- Apply established safety procedures in welding, brazing, and cutting operations
- Identify various torches and their uses in manufacturing processes
- Prepare oxyacetylene components
- Adjust regulators and connections to specifications
- Weld, braze, and cut with appropriate equipment
- Follow established shut-down procedures for oxyacetylene equipment
- Secure oxyacetylene equipment in designated area

Perform soldering operations

Key Indicators:

- Select grade and type of solder appropriate for given task
- Select size of soldering gun or iron appropriate for given task
- Prepare joint for soldering
- Perform soldering techniques for specified manufacturing processes or tasks
- Apply established safety procedures
- Secure soldering gun or iron in designated area

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Cut materials (e.g., metals and plastics)

Key Indicators:

- Apply established safety procedures in all cutting operations
- Identify the types of materials used in manufacturing processes
- Select the cutting tools and method appropriate for the type of material
- Determine size of cut needed using appropriate measuring device
- Cut materials using tin snips
- Cut materials using hacksaw
- Cut materials using metal shears
- Cut materials using cutting wheels

Test materials for type and quality

Key Indicators:

- Locate needed information using bills of material on appropriate reference blueprints
- Determine the classification and physical properties of ferrous and nonferrous metals
- Demonstrate knowledge of test methods (e.g., American Society for Testing and Materials [ASTM], International Organization for Standardization ([ISO])
- Perform spark tests
- Perform magnetic tests
- Perform scratch tests using a file
- Perform burn tests for plastics

Working Responsibly - Strand 4

Industrial & Engineering Systems Career Cluster ITAC — Manufacturing

Expectation

Employees in the manufacturing sector today are subject to a high standard of personal and professional accountability. Individuals must daily demonstrate a strong work ethic, including — but not limited to — honesty, initiative, and dependability. Individuals must be able to discern between right and wrong in difficult or subtle situations. Then, they must act with rightness, fairness, and equity. Individuals must be free from petty, mean, or dubious conduct if an organization is to thrive. Without high standards of ethical conduct on both sides, individuals and organizations are subject to low morale and a host of management, legal, economic, and political problems.

Competencies

Exhibit business and work ethics

Demonstrate the ability to work on a team in a manufacturing environment

Identify legal issues and regulatory standards applicable to the manufacturing industry

Sample Scenario

You are a head of an engineering design department. In your department, you have CAD drafters and project design engineers. Recently, you have noticed an increased frequency in shop-generated requests for engineering changes related to product designs. As a result, production is inefficient and there are tensions between the designers and the workers. The shop workers feel their opinions are not valued, and people are trying to place the blame on others. You need to develop a strategy to reduce the requests for engineering changes. It is clear that a major problem has been insufficient communications between the engineering department and shop personnel at the time each product was originally designed. You need to develop and implement communication processes which ensure timely input into initial design and production and which foster teamwork for all. You will need to prepare a document for your employer that details both the communication problems and the processes you plan to implement.

Guiding Questions

- How will you pinpoint the communication problems?
- What assistance will you require from employees to implement the processes?
- What assistance or resources will you require from your employer?
- How will you assess alternative solutions?
- How will you determine the effectiveness of the proposed communication processes?
- How will you present the solutions to your employer?

Core ITAC	Competency Connections
Strand 1: Solving Problems and Thinking Skillfully	1.1, 1.2, 1.3, 1.7
Strand 2: Communicating Effectively	2.1, 2.2, 2.5, 2.11
Strand 3: Applying Technology	None
Strand 4: Working Responsibly	4.1, 4.2, 4.3, 4.4, 4.6
Strand 5: Planning and Managing a Career	None
Strand 6: Managing Resources	6.1, 6.2, 6.4

Academic Connections

Social Studies	• **Democratic Processes:** Analyze and evaluate situations in which individual rights conflict with each other or with other important interests • **Democratic Processes:** Analyze governmental actions in the United States federal system on the basis of the fundamental principles of American democracy, and evaluate the extent to which the actions reflect those principles and help to serve the public good • **Democratic Processes:** Justify proposed solutions to current issues by explaining how they adhere to democratic principles • **Citizens Rights and Responsibilities:** Acquire, interpret, and analyze information regarding civic issues • **Citizens Rights and Responsibilities:** Evaluate positions on the proper scope and limits of individual rights in specific situations
Language Arts	• **Reading/Meaning Construction:** Read to clarify personal thinking and understanding • **Reading/Application:** Employ various reading strategies according to purpose

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Competencies & Key Indicators

Exhibit business and work ethics

Key Indicators:

- Attend work as scheduled
- Follow established rules of conduct
- Exhibit characteristics and responsibilities of teamwork
- Exhibit characteristics of a productive employee (friendliness, honesty, loyalty, initiative, flexibility, positive attitude, punctuality, accountability)
- Respect property of customers and others
- Prioritize work

Demonstrate the ability to work on a team in a manufacturing environment

Key Indicators:

- Identify types of teams (e.g., cross-functional, cross-trained)
- Identify the role of teams in high-performance workplaces
- Analyze unique issues associated with working on teams
- Apply problem-solving and conflict-resolution practices

Identify legal issues and regulatory standards applicable to the manufacturing industry

Key Indicators:

- Demonstrate knowledge of contracts
- Demonstrate knowledge regarding negligence and its consequences (e.g., drug testing, harassment)
- Identify established company/agency policies for dealing with legal issues

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Planning and Managing a Career - Strand 5

Industrial & Engineering Systems Career Cluster ITAC — Manufacturing

Expectation

Since the world of manufacturing offers an array of career opportunities, individuals need to be actively engaged in seeking a career that matches their interests, abilities, aptitudes, and skills. Career planning enhances the possibility that one's career path will lead to success and satisfaction in work. Employers seek individuals who know what they want from work and can effectively present their qualifications and skills through the job search process, including job applications and interviews. Throughout one's career, it is also important to seek continuous professional development opportunities.

Competencies

- Explore careers in the manufacturing industry
- Seek employment in the manufacturing industry
- Plan for professional development
- Manage professional career

Sample Scenario

You have been working as a draftsperson and are very much interested in advancing your career in the manufacturing industry. Your employer will provide tuition assistance if you establish a plan for your professional development. Explore qualifications for various positions and develop a plan to obtain your career goals. Include a career ladder, education and training opportunities, and a plan for seeking future positions. Present your plan to a panel of employer representatives.

Guiding Questions

- How will you find out about the variety of careers in the manufacturing industry?
- How will you determine your match (interests, attitudes, and abilities) to a career choice?
- After you identify interest in a specific career, how will you find out about educational requirements and training opportunities?
- How will professional organizations impact your career?

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Core ITAC	Competency Connections
Strand 1: Solving Problems and Thinking Skillfully	1.1, 1.2, 1.3
Strand 2: Communicating Effectively	2.1, 2.2, 2.3, 2.5
Strand 3: Applying Technology	3.1, 3.3
Strand 4: Working Responsibly	None
Strand 5: Planning and Managing a Career	5.1, 5.2, 5.3, 5.4
Strand 6: Managing Resources	6.2

Academic Connections

Language Arts	• **Writing/Structure:** Evaluate and revise writing to focus on such things as audience, tone, and purpose • **Writing/Application:** Consider audience and purpose for writing • **Oral Communication/Meaning Construction:** Communicate orally to inform and persuade • **Oral Communication/Application:** Practice interviewing techniques • **Oral Communication/Application:** Use oral communication for a variety of purposes and audiences
Science	• **Applications for Science Learning:** Refine personal career interests through investigations of the diversity of manufacturing, research, service, and invention processes

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Competencies & Key Indicators

Explore careers in the manufacturing industry

Key Indicators:

- Identify the range of careers in the manufacturing industry
- Explore specific manufacturing interests (e.g., through job shadowing; worksite experience; review of print, audiovisual, and electronic sources; interviews, community service)
- Identify educational requirements for different manufacturing careers
- Identify available programs providing needed education/training
- Research projected growth and availability, both locally and nationally, of various manufacturing careers

Seek employment in the manufacturing industry

Key Indicators:

- Prepare documentation needed for obtaining a position
- Update documents needed for manufacturing employment
- Compile documents in a professional manner
- Identify employment opportunities
- Dress appropriately for job interview
- Present credentials, philosophy, and goals in job interview for a manufacturing position
- Identify the steps to follow in leaving a manufacturing position

Plan for professional development

Key Indicators:

- Identify the role of professional organizations in the professional development process
- Keep up-to-date by reading professional publications, attending conferences, and searching the Internet
- Determine the benefits to business of employees' belonging to professional organizations (membership, networking)
- Examine the benefits of belonging to civic and community organizations
- Determine the areas of continuing education needed in manufacturing
- Examine the benefits of continuing education for the manufacturing industry

Manage professional career

Key Indicators:

- Set personal goals
- Plan for career growth
- Develop skills and characteristics needed to meet professional goals
- Identify possible advancement patterns in manufacturing careers
- Monitor progress toward professional goals

Managing Resources - Strand 6

Industrial & Engineering Systems Career Cluster ITAC — Manufacturing

Expectation

In modern high-performance manufacturing workplaces, all individuals must effectively manage a variety of resources — personal, financial, and environmental. Individuals' ability to maintain a safe working environment ensures the maintenance of good personal health as well as that of coworkers. The employee must also appreciate the importance of prudent inventory control and preventive maintenance measures as ways to increase productivity, which ultimately contributes to the success of the organization.

Competencies

- Analyze information from job-related reference materials
- Maintain general safety in accordance with government regulations and health standards
- Handle hazardous materials in accordance with government regulations and health standards
- Handle tools, materials, and equipment in accordance with government regulations and health standards
- Comply with company safety procedures
- Control material and product inventories to meet customer and business requirements
- Perform preventive maintenance in accordance with guidelines specified by manufacturer and/or outside authorities with jurisdiction

Sample Scenario

Your employer has recently added the duty of safety coordinator to your job description. The company employs approximately 100 workers, most of whom have frequent contact with various solvents and other chemicals involved in the manufacturing of inks and dyes. OSHA has recently cited the company for noncompliance to hazardous communications regulations and standards. Specifically, the company had no records regarding training, some containers were improperly labeled, and MSDSs were not available to the workers. You have been charged with the responsibility for developing a plan to correct the violations and create new procedures for ensuring compliance. Your employer expects you to present to her a plan that will satisfy OSHA regulations.

Guiding Questions

- What are the major problems that you must address?
- What would be the possible consequences of not adhering to OSHA regulations and standards?
- How will you find out more about OSHA regulations and standards for ink and dye manufacturing?
- What resources do you have for developing and implementing the plan?
- What communications tools are needed to implement the plan?
- How will you determine success of the plan?

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Core ITAC	Competency Connections
Strand 1: Solving Problems and Thinking Skillfully	1.1, 1.2, 1.3, 1.4, 1.7
Strand 2: Communicating Effectively	2.1, 2.3
Strand 3: Applying Technology	3.1, 3.3
Strand 4: Working Responsibly	4.3, 4.4
Strand 5: Planning and Managing a Career	None
Strand 6: Managing Resources	6.1, 6.2, 6.4, 6.5, 6.6, 6.10

Academic Connections

Social Studies	• **Democratic Processes:** Analyze governmental actions in the United States federal system on the basis of the fundamental principles of American democracy, and evaluate the extent to which the actions reflect those principles and help to serve the public good
Language Arts	• **Reading/Meaning Construction:** Confirm and extend meaning in reading by researching new concepts and facts • **Reading/Application:** Employ various reading strategies according to purpose • **Reading/Application:** Read selections from a variety of styles and formats, recognizing that style and format influence meaning
Science	• **Scientific Inquiry:** Document potentially hazardous conditions and associated risks in selected homes and public areas • **Applications for Science Learning:** Do simple troubleshooting on common electrical and mechanical systems, identifying and eliminating possible causes of malfunctions

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Competencies & Key Indicators

Analyze information from job-related reference materials

Key Indicators:

- Locate needed reference materials
- Select useful support materials and documentation
- Interpret information (e.g., text, graphics, tables) provided in production or reference materials

Maintain general safety in accordance with government regulations and health standards

Key Indicators:

- Wear protective clothing appropriate for job (hard hat, hard-toed shoes, buttoned-sleeve shirt, gloves, eye protection, etc.)
- Wear protection devices appropriate for job (dust mask, hearing protection, respirators)
- Check self for potential hazards (secure hair, remove jewelry)
- Practice established lifting techniques
- Maintain personal protective equipment (inspect, clean, replace)
- Follow established procedures for the use of safety apparatus and equipment, including fall protection
- Conduct routine equipment safety inspections
- Check power sources for potential hazards
- Confirm proper grounding
- Shut down power equipment in dangerous situations using power disconnect switches and established lock-out/tag-out procedures
- Use emergency flush showers, eye-wash fountains, first-aid stations, fire alarms, and exits in accordance with established procedures
- Maintain work areas in accordance with standards for cleanliness and safety
- Interpret personal safety rights according to shop's Right-to-Know Plan
- Demonstrate knowledge of how to operate fire extinguishers and of classes of fires
- Inspect air makeup and exhaust systems, including intake filters, exhaust filters, fan, and other mechanical components

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Handle hazardous materials in accordance with government regulations and health standards

Key Indicators:

- Identify types of hazardous materials
- Interpret material safety data sheets (MSDSs)
- Interpret container label precautions
- Store hazardous materials in accordance with government regulations
- Dispose of hazardous materials in accordance with government regulations

Handle tools, materials, and equipment in accordance with government regulations and health standards

Key Indicators:

- Follow established procedures for the safe use of tools, materials, and equipment, including operation, carrying, lifting, and handling
- Identify potential hazards associated with hand and power tools
- Conduct routine inspections of tools and equipment
- Maintain hand tools, power tools, and equipment

Comply with company safety procedures

Key Indicators:

- Demonstrate knowledge of company safety procedures (e.g., evacuation, fire drill)
- Identify roles and responsibilities of employer and employees
- Follow environmental precautions when discarding parts

Control material and product inventories to meet customer and business requirements

Key Indicators:

- Analyze the relationship of quality control to supply of materials
- Identify inventory-control systems used in manufacturing (e.g., just-in-time)
- Analyze the impact of inventory-control systems on productivity and profit/loss

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Perform preventive maintenance in accordance with guidelines specified by manufacturer and/or outside authorities with jurisdiction

Key Indicators:

- Maintain operating and maintenance records
- Access needed information from past maintenance records
- Follow preventive maintenance schedule
- Access needed information using preventive maintenance manuals
- Log preventive maintenance performed

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